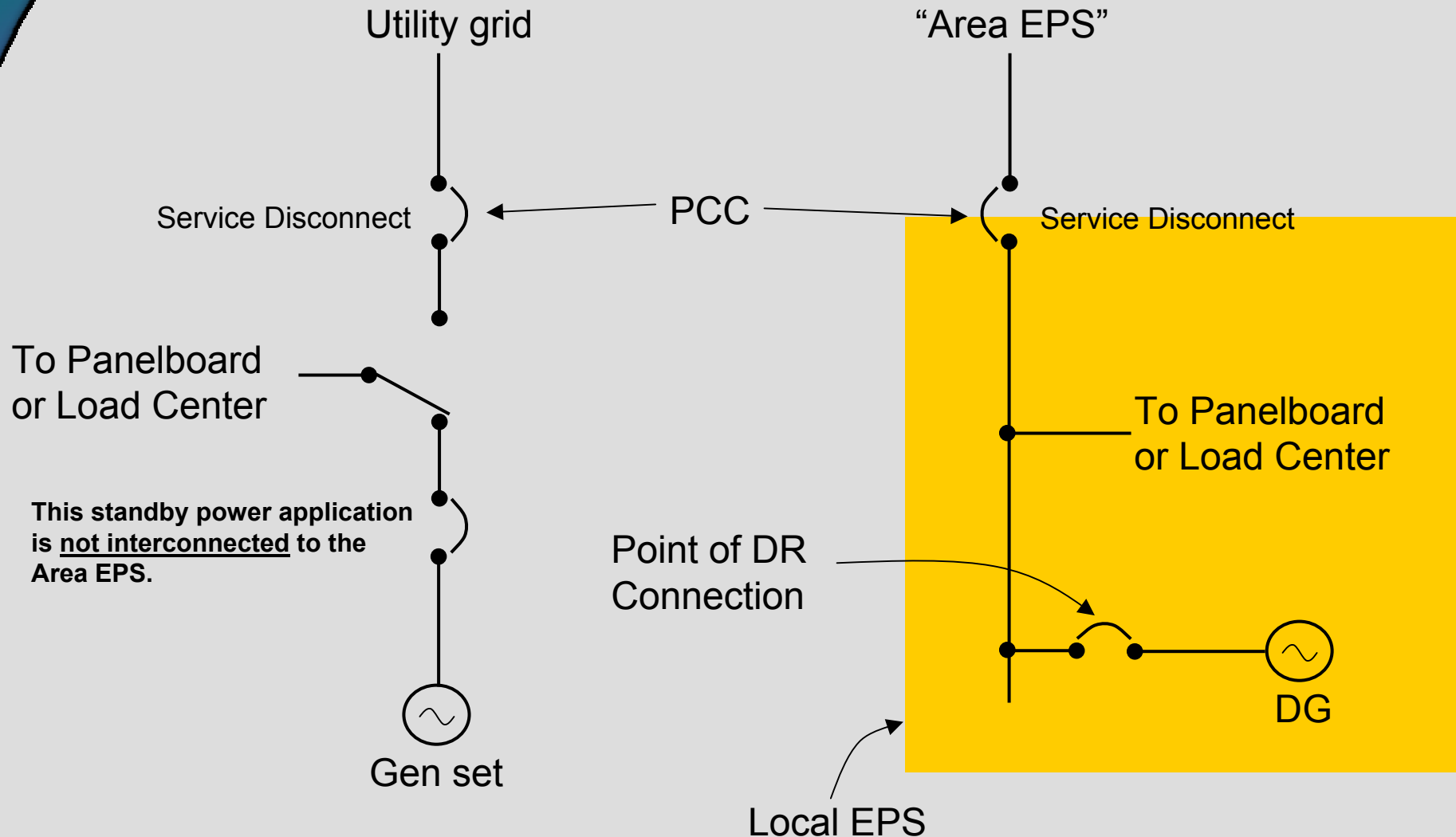


DG Interconnection

U.S. Department of Energy
Office of Distributed Energy & Electric
Reliability
2003

What is an “interconnection”?



Definitions (cont.)

- ▶ Local Electric Power System (EPS) is the customer side of the meter;
- ▶ Area EPS is the utility side of the meter;
- ▶ Point of Common Coupling (PCC) is the meter. Similar to NEC definition of “Service Point”;
- ▶ Point of DR Connection is the generator disconnect means;
- ▶ Islanding means energizing a local or area EPS that is disconnected from the bulk power grid.

Definitions (cont.)

► Modes of operation

- **Emergency**

- Disconnected from the grid; and only when grid is “de-energized”
- Example: blackout caused by lightning
- Usually done with a “break-before-make” transfer switch – most common, established technology

- **Isolated**

- Disconnected from the grid, but utility may be energized
- Example: utility pays you to cut your consumption
- Can be “break-before-make” or “make-before-break” transfer switch

- **Base Load**

- Connected to the grid, the generator is running constantly
- Example: generator and boiler (“co-gen”) at a hospital, university
- Does not use a transfer switch, utility supplies peaking power

- **Peak Shaving**

- Connected to the grid, power output varies
- Example: Reduce your demand charges by running your own generator
- Does not use transfer switch, utility supplies base load

Standards Activities

► New Standards Activities

- IEEE P1547 – Interconnecting Distributed Resources with Electric Power Systems (standard)
- UL 1741 – Static Inverters and Charge Controllers for Use in Photovoltaic Power Systems (standard)
 - Will incorporate IEEE P1547 in next revision (within 18 months)
- IEEE P1589 – Conformance Test Procedures for P1547 (standard)
- IEEE P1608 – Application Guide for P1547 Installations (guide)
- IEEE P1614 – Guide for Monitoring and Info Exchange (guide)

► Related Interconnection Standards

- NFPA 70 – National Electrical Code (standard)
- UL 891 and UL 1558 – Paralleling Switchgear (standard)

IEEE P1547

Standard for Interconnecting Distributed Resources with Electric Power Systems

► Highlights

- 10 MW generators or smaller
- Standard applies to measurements made at the PCC
- 1547 deals with **utility** issues, not traditional safety issues. For example,
 - “The DR shall not actively regulate voltage at the PCC.”
 - “The DR shall not energize the Area EPS (grid) when the Area EPS is de-energized.”

P1547 Technical Requirements

► General Requirements

- Voltage Regulation
- Integration with Area EPS Grounding
- Synchronization
- Secondary and Spot Networks

► Response to Area EPS Abnormal Conditions

- Area EPS Faults
- Area EPS Reclosing Coordination
- Voltage

► Power Quality

- Limitation of DC Injection
- Harmonics

► Islanding

- Unintentional Islanding

- Inadvertent Energizing of
–the Area EPS
- Monitoring
- Isolation Device
- Interconnect Integrity
-

- Frequency
- Loss of Synchronism
- Reconnection to Area EPS

- Limitation of Voltage Flicker
–Induced by the DR

- Intentional Islanding

P1547 Test Requirements

▶ Design Test

- Abnormal Voltage and Frequency
- Synchronization
- Interconnection Integrity
- Unintentional Islanding
- Limitations of DC Injection
- Harmonics

▶ Production Tests

▶ Interconnection Installation Evaluation

- Grounding Integration w/Area EPS
- Isolation Device
- Monitoring Provisions
- Area EPS Faults
- Area EPS Reclosing

▶ Commissioning Tests

- Unintentional Islanding
- Cease to Energize

▶ Periodic Interconnection Tests

Certification

UL 1741 or equivalent from another NRTL

- ▶ UL 1741 applies when the DG is connected to the EPS through an inverter.
- ▶ Virtually all new technologies require inverter electronics.
 - Fuel cell, microturbine, solar panel, battery, flywheel, windmill.
- ▶ Product certification
 - Specific inverter product line
- ▶ Field certification
 - Certifies an installation through an on-site test procedure

Issues traditionally managed by your local utility

- ▶ Ensure safety of utility maintenance personnel
 - Anti-islanding
 - Lock out provisions
- ▶ Ensure reliability and adequacy of power delivery
 - Voltage regulation
 - Feeder upgrades
 - Protective relay settings
- ▶ Ensure adequate return on investment
 - Contract negotiations

Issues traditionally within the jurisdiction of the code official

- ▶ Ensure safety of personnel
 - NFPA 70
 - UL listing
 - Local safety codes

- ▶ Informal channels of communication with utility

Suggested Thought Process

1. Does the installation include a generator or grid-connected storage?
 2. If 1) is yes, is there a break-before-make transfer switch? If yes, then P1547 does not apply.
 3. If 2) is no, is there a make-before-break transfer switch? If yes, then P1547 applies if generator remains connected longer than 1/10th second.
 4. If 2) and 3) are no, then the generator is “interconnected”. P1547 does apply. Utility involvement is probably required.
 5. If 2) and 3) are no, is there an inverter? You should suspect the presence of an inverter if the generator is not a gas turbine larger than 100 kW or a diesel or gasoline engine of any size. Check inverter for UL 1741 compliance.
- Of course, NFPA 70 still prevails on the customer side of the meter.